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FLOOD INSURANCE STUDY

ORIGINAL

NORMAN COUNTY, MINNESOTA

UNINCORPORATED AREAS

REVISED:

AUGUST 19, 1987

Federal Emergency Management Agency

COMMUNITY NUMBER - 270322

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CDD

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

This publication incorporates revisions to the original Flood Insurance Study. These revisions are presented in Section 9.0.

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Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

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FLOOD INSURANCE STUDY

1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this Flood Insurance Study is to investigate the existence and severity of flood hazards in the unincorporated areas of Norman County, Minnesota, and to aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Initial use of this information will be to convert Norman County to the regular program of flood insurance by the Federal Insurance Administration. Further use of the information will be made by local and regional planners in their efforts to promote sound land use and flood plain development.

1.2 Coordination

The areas requiring detailed study were identified at a meeting attended by representatives of Norman County, the Federal Insurance Administration, the Minnesota Department of Natural Resources, and the study contractor on March 16, 1976. The representatives at the meeting selected streams for both detailed and approximate study, basing their decisions on current and potential development patterns in Norman County.

The U.S. Geological Survey, the U.S. Army Corps of Engineers, and the U.S. Soil Conservation Service were contacted for coordination in preparing this Flood Insurance Study.

The results of this study were reviewed at a final community coordination meeting held on September 9, 1980. Attending the meeting were representatives of the Federal Insurance Administration, the study contractor, and the county. This study incorporates all appropriate comments, and all problems have been resolved.

1.3 Authority and Acknowledgments

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for this study were performed by Barr Engineering Company, for the Federal Insurance Administration, under Contract No. H-3982. This work, which was completed in March 1979, covered all significant flooding sources affecting Norman County.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the unincorporated areas of Norman County, Minnesota. The area of study is shown on the Vicinity Map (Figure 1).

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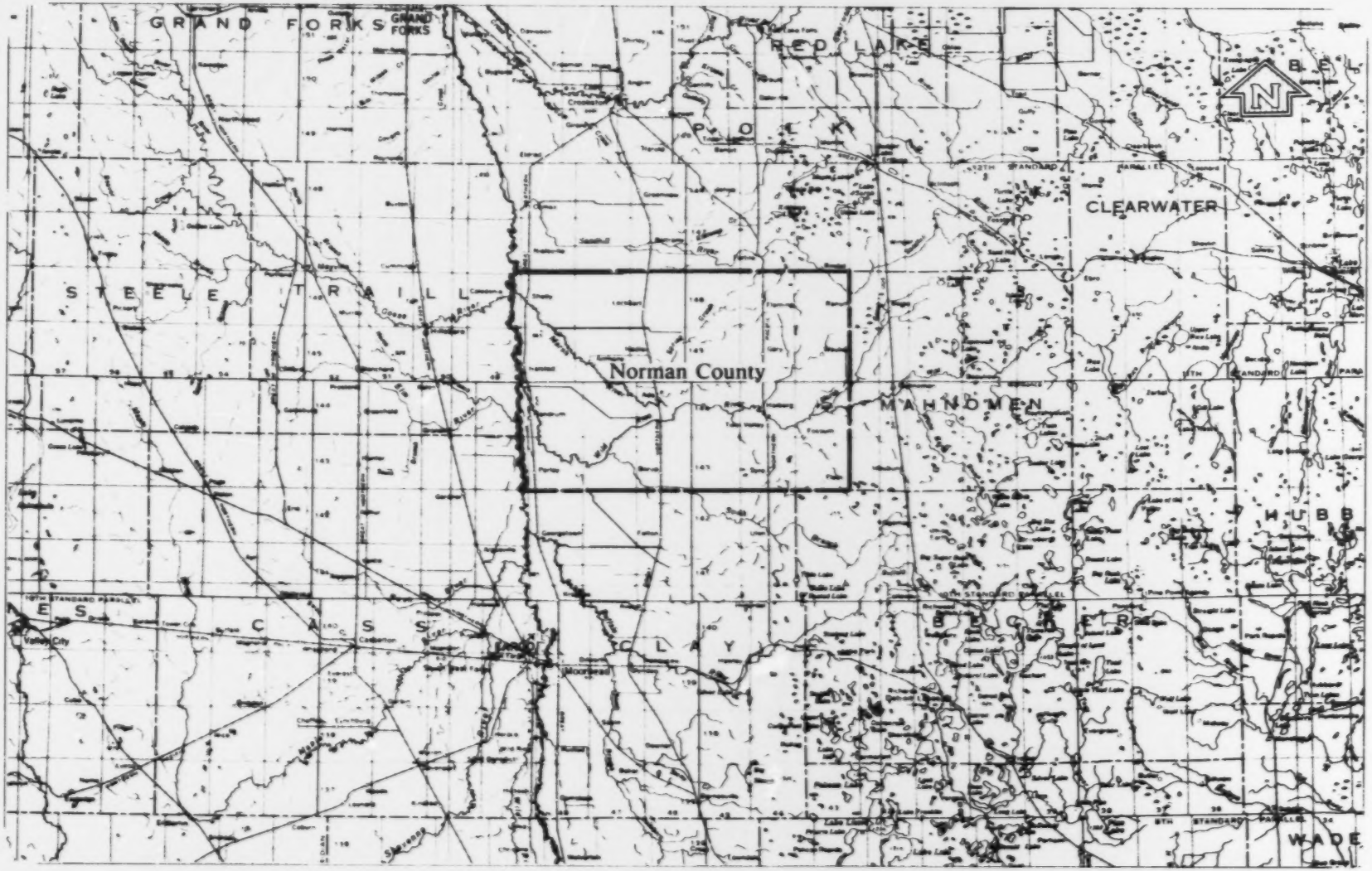

FEDERAL EMERGENCY MANAGEMENT AGENCY

NORMAN COUNTY, MN
(UNINCORPORATED AREAS)

APPROXIMATE SCALE
16 0 16 32 48 MILES

VICINITY MAP

FIGURE 1

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The incorporated Cities of Hendrum, Halstad, Ada, and Perley have been excluded from this study.

Flooding caused by the overflow of the following rivers was selected for detailed study:

Red River of the North, from the south section line of Section 36, T. 143 N., R. 49 W., downstream to the south section line of Section 25, T. 146 N., R. 49 W. (at Hendrum)

Wild Rice River, from the south section line of Section 29, T. 144 N., R. 48 W., downstream to the extreme northwest corner of Section 18, T. 144 N., R. 48 W. (near Ada)

Wild Rice River, from the north section line of Section 23, T. 144 N., R. 46 W., downstream to the west section line of Section 30, T. 144 N., R. 46 W.

Marsh River was originally selected for detailed study from the west section line, Section 15, T. 144 N., R. 46 W., downstream to the west section line of Section 18, T. 144 N., R. 46 W. Because the flooding in this area was determined to be controlled by Wild Rice River, Marsh River is included in the analysis of Wild Rice River.

Overflow of the following rivers was studied by approximate methods because no significant development is expected in these areas through 1984.

All reaches of the Red River of the North, in Norman County, which were not studied by detailed methods

Wild Rice River, from the center of Section 15, T. 144 N., R. 45 W., to its confluence with Red River of the North, excluding detailed study reaches

South Branch Wild Rice River, from the center of the east section line of Section 31, T. 143 N., R. 46 W., downstream to its confluence with Wild Rice River

Marsh River, from west section line of Section 20, T. 146 N., R. 48 W., to its confluence with Red River of the North

Those areas studied by detailed methods were chosen with consideration given to all proposed construction and forecasted development through 1984.

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2.2 Community Description

Norman County is in northwestern Minnesota, on Red River of the North, which is the border between Minnesota and North Dakota. Norman County is bordered by Clay and Becker Counties, Minnesota, to the south; Mahnomen County, Minnesota, to the east; Polk County, Minnesota, to the north; and Cass and Traill Counties, North Dakota, to the west.

The county has an area of approximately 885 square miles, and had a 1970 population of 10,008 (Reference 1). A slight population decrease is projected by 2000 (Reference 1).

Red River of the North flows northerly along the western county limits. Marsh River flows northwesterly from its headwaters near the City of Ada to its confluence with Red River of the North near the City of Shelly. Wild Rice River flows westerly from its headwaters in Clearwater County to its confluence with Red River of the North near Halstad. South Branch Wild Rice River flows northwesterly from its headwaters in south-central Norman County to its confluence with Wild Rice River near County Highway 14.

Most of Norman County is on the lakebed of former glacial Lake Agassiz. The former shoreline of the glacial lake lies along the eastern edge of the county.

The county has a humid continental climate characterized by large seasonal variations in temperature. The mean monthly temperature varies from 3°F in January to 70°F in July, and the mean annual temperature is 40°F. The average annual precipitation is approximately 21 inches. The average annual snowfall is 30 inches and represents 14 percent of the total annual precipitation (Reference 2).

Vegetation in Norman County consists primarily of agricultural crops (wheat, barley, oats, sunflowers, and sugar beets), urban ornamental plants and shrubs, and scattered trees along Red River of the North, Wild Rice River, and Marsh River. The soils include clayey glacial drift overlying Cretaceous shale with thin beds of sand (Reference 3).

Major highways and railroads in Norman County include:

U.S. Highway 75, adjacent and parallel to Red River of the North. It crosses Marsh River south of Shelly and Wild Rice River north of Hendrum.

State Highway 9, located in central Norman County, parallel to U.S. Highway 75. It crosses Wild Rice River and Marsh River just south of Ada.

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County Highway 39, which passes east and west through southern Norman County. It crosses South Branch Wild Rice River near Borup and Red River of the North near Perley.

State Highway 200, which passes east and west through central Norman County. It crosses Red River of the North near Hendrum and Marsh River near Ada.

County Highway 3, which passes east and west through northern Norman County. It crosses Marsh River and Red River of the North near Shelly.

The Burlington Northern Railroad, adjacent and parallel to Red River of the North. It crosses Wild Rice River near Hendrum and Marsh River near Shelly.

The Burlington Northern Railroad, which passes north and south through central Norman County. It crosses Marsh River and Wild Rice River south of Ada.

Development throughout Norman County is primarily agricultural. Flood plains are predominantly agricultural and flood plain development is expected to be minimal in the future.

2.3 Principal Flood Problems

Floods on Marsh River, Red River of the North, South Branch Wild Rice River, and Wild Rice River occur primarily as a result of snowmelt runoff, although flooding has resulted from the occurrence of short-duration, high-intensity rainstorms. A recent flood on Red River of the North at Halstad occurred during the spring of 1978 and had a recurrence interval of approximately 15 to 20 years. The largest known flood on Red River of the North at Halstad occurred in 1979 and had a recurrence interval of 60 years. Other large floods on Red River of the North in the Halstad area occurred in 1947, 1965, 1966, 1969, and 1975 (Reference 4).

The most recent and largest flood on Wild Rice River at Hendrum occurred during the spring of 1978. It had a recurrence interval of 55 years. Other large floods on Wild Rice River at Hendrum occurred in 1947, 1965, 1966, 1969, 1975, and 1979 (Reference 4).

No historic flood data are available for Marsh River near Ada.

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2.4 Flood Protection Measures

Norman County has no state-approved flood plain zoning ordinances. Flood protection structures on Wild Rice River near Ada include a ditch which diverts some flow from Wild Rice River to Marsh River. This diversion ditch was constructed by local interests and improved by the U.S. Army Corps of Engineers. Downstream of the diversion, the U.S. Army Corps of Engineers constructed a gated culvert which also diverts some flow from Wild Rice River to Marsh River. In addition, the U.S. Army Corps of Engineers has straightened the Wild Rice River channel south of Ada. Flood protection structures along Red River of the North include temporary dikes at Halstad, Hendrum, and Perley. The dikes have not, however, been officially certified by the U.S. Army Corps of Engineers as adequate to provide protection from the 100-year flood.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual occurrence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported here reflect flooding potentials based on conditions existing in the county at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each stream studied in detail in the county.

Gaging records from U.S. Geological Survey stations at Halstad, Minnesota, and Fargo, North Dakota, provided the principal data used for defining the discharge-frequency relationship for Red River of the North (Reference 4). The U.S. Geological Survey developed the discharge-frequency relationship (Reference 5) using a log-Pearson Type III (Reference 6) analysis with 30 years of gaging station records at Halstad (1936, 1937, 1942 through 1969)

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and 68 years of record at Fargo (1902-1969). The U.S. Army Corps of Engineers also developed discharge-frequency relationships using the same record extended through 1976 (Reference 7). Both agencies used the floods of 1882, 1893, and 1897 graphically to adjust the frequency curve.

Discharges for Wild Rice River near Hendrum were developed using a log-Pearson Type III (Reference 6) analysis and 32 years (1944 through 1975) of U.S. Geological Survey gaging station records from Hendrum (Reference 4). Discharges for Wild Rice River at Ada were determined from a discharge-distribution curve developed for the diversion between Marsh River and Wild Rice River at County Highway 24. The discharge-distribution curve developed by the U.S. Army Corps of Engineers, St. Paul District, in their design memorandum for flood control of Twin Valley Lake (Reference 8), was extended and used to determine those discharges.

Peak discharge-drainage area relationships for Red River of the North and Wild Rice River are shown in Table 1.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of streams in the county were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each stream studied in the county.

Water-surface elevations for floods of the selected recurrence intervals on Red River of the North and Wild Rice River were determined using Manning's equation, step-backwater calculations, and the HEC-2 computer program (Reference 9). Cross sections used in the hydraulic analyses were located along the watercourses to provide typical representations of the stream valley terrain. Additional cross sections were located at close intervals upstream and downstream of channel constructions, such as bridges, to allow computation of the significant backwater effects caused by the constrictions. Cross sectional data and elevations and dimensions of bridges and other hydraulic structures were obtained by field survey.

Effective flow areas of the flood plain cross sections, loss coefficients for bridges, and channel and overbank roughness coefficients (Manning's "n") were initially assigned to each cross section using field inspection data, aerial photographs (Reference 10), and U.S. Geological Survey topographic maps (Reference 11).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

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Table 1. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second) 10-Year	50-Year	100-Year	500-Year
Red River of the North					
At County Highway 39	19,000	22,400	38,900	46,900	68,500
At Minnesota Highway 200	21,800	25,000	42,000	50,000	71,000
Wild Rice River					
At Hendrum, County Highway 25	1,600	6,100	9,700	11,500	16,100
Near Ada, County Highway 24	1,090	2,900	6,500	8,400	14,200

Hydraulic coefficients and Manning's equation were adjusted to match the historic profile of the 1969 flood on Red River of the North (Reference 12), the 1975 flood on Wild Rice River at Hendrum (Reference 13), and the 1975 flood on Wild Rice River near Ada (Reference 13). Adjusted coefficients were then used to determine the 10-, 50-, 100-, and 500-year frequency flood profiles. Manning's "n" coefficients used varied from 0.030 to 0.045 in the channel and from 0.035 to 0.200 in the overbanks for Red River of the North; from 0.035 to 0.045 in the channel and from 0.045 to 0.200 in the overbanks for Wild Rice River near Hendrum; and from 0.050 to 0.060 in the channel and from 0.060 to 0.200 in the overbanks for Wild Rice River near Ada.

Starting water-surface elevations for the 10-, 50-, 100-, and 500-year floods for Red River of the North and Wild Rice River at Hendrum were obtained from the Halstad Flood Insurance Study (Reference 14), the Hendrum Flood Insurance Study (Reference 15), and the Perley Flood Insurance Study (Reference 16). The starting water-surface elevations for the 10-, 50-, 100-, and 500-year floods on Wild Rice River near Ada were calculated using Manning's equation.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1).

Although flood elevations on Red River of the North, Wild Rice River at Hendrum, and Wild Rice River near Ada in Norman County can be raised by debris accumulation and ice jams at hydraulic structures, the hydraulic analyses for this study are based only on unobstructed flow. The flood elevations shown on the water-surface profiles are considered valid only if hydraulic structures remain generally unobstructed, operate properly, and do not fail. Changes in existing bridge dimensions and elevations could also affect the given water-surface elevations.

Approximate 100-year water-surface elevations for Red River of the North and Marsh River at Shelly were estimated and coordinated with the Halstad Flood Insurance Study (Reference 14), the Hendrum Flood Insurance Study (Reference 15), and the Perley Flood Insurance Study (Reference 16). Approximate 100-year water-surface elevations for Wild Rice River were estimated using Manning's equation and U.S. Geological Survey topographic maps (Reference 11); approximate 100-year water-surface elevations for South Branch Wild Rice River were estimated using data from U.S. Geological Survey topographic maps (Reference 11).

In areas with shallow flooding, water velocity is low due to water overtopping roads and/or high ground restricting flow. Depths were determined from U.S. Geological Survey topographic maps (Reference 11), using flood elevations computed adjacent to these areas

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All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

A prime purpose of the National Flood Insurance Program is to encourage State and local governments to adopt sound flood plain management programs. Each Flood Insurance Study, therefore, includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the Federal Insurance Administration as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the county. For each stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000, with a contour interval of 5 feet (Reference 11).

The approximate 100-year flood boundaries on Marsh River, Red River of the North, South Branch Wild Rice River, and Wild Rice River were delineated on U.S. Geological Survey topographic maps at a scale of 1:24,000 with a contour interval of 5 feet (Reference 11).

Approximate flood boundaries in some portions of the study area were taken from the Federal Insurance Administration's Flood Hazard Boundary Map (Reference 17).

Flood boundaries for the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood boundaries are close together, only the 100-year flood boundary has been shown. Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity and increases flood heights, thus increasing flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic

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gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment in order that the 100-year flood be carried without substantial increases in flood heights. As minimum standards, the Federal Insurance Administration limits such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced.

Regulations in Minnesota limit flood plain encroachment to that which would cause a 0.5-foot increase in flood heights above pre-floodway conditions at any point. However, floodways for Red River of the North were evaluated to determine the floodway conveyance capacity that would result in no more than an 0.8-foot increase in flood heights above the prefloodway conditions. The 0.8-foot surcharge was used because Red River of the North forms the boundary between Minnesota and North Dakota. The 0.8-foot surcharge was determined from the one-half of the allowable 1.0-foot floodway on the North Dakota side and the one-half of the allowable 0.5-foot floodway on the Minnesota side. The 0.8-foot surcharge was determined by adding the allowable 0.5-foot and 0.25-foot surcharges, which equals 0.75 foot. This elevation was then rounded to the nearest 0.1 foot, 0.8 foot.

The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood boundaries are close together, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 0.8 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

The loss of significant amounts of overbank storage in the flood fringe adjacent to the conveyance floodway would increase the peak flood discharges on Red River of the North, resulting in flood stages in excess of the allowable 0.8-foot rise.

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA[2] (SQUARE FEET)	MEAN VELOCITY[2] (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Red River of the North								
A	10.32	410	8,640	1.5	863.6	863.6	864.4	0.8
B	13.28	270	7,760	1.3	864.3	864.3	865.1	0.8
C	14.43	1,820	25,180	1.2	864.5	864.5	865.3	0.8
D	15.02	1,890	16,950	1.3	864.7	864.7	865.5	0.8
E	16.20	260	11,600	1.0	865.1	865.1	865.9	0.8
F	16.55	1,750	17,390	1.1	865.2	865.2	866.0	0.8
G	17.54	3,820	27,570	1.2	865.6	865.6	866.4	0.8
H	18.12	1,760	19,810	1.3	865.8	865.8	866.6	0.8
I	18.84	4,560	30,010	1.2	866.0	866.0	866.8	0.8
J	21.04	4,710	47,800	0.7	866.5	866.5	867.3	0.8
K	22.17	3,210	49,850	0.6	866.7	866.7	867.5	0.8
L	24.06	3,800	47,850	0.8	867.1	867.1	867.9	0.8
M	24.43	1,820	20,480	1.1	867.1	867.1	867.9	0.8
N	25.49	530	7,350	1.9	867.4	867.4	868.2	0.8
O	26.42	4,460	53,850	0.7	867.7	867.7	868.5	0.8
P	28.05	1,910	26,790	1.3	867.9	867.9	868.7	0.8
Q	29.63	4,430	63,980	0.7	868.2	868.2	869.0	0.8
R	30.54	1,830	29,890	1.2	868.3	868.3	869.1	0.8
S	31.70	2,910	28,040	1.3	868.7	868.7	869.5	0.8
T	36.94	850	10,650	1.9	872.5	872.5	873.3	0.8
U	38.47	2,450	14,960	1.6	873.3	873.3	874.1	0.8
V	40.04	3,500	16,970	1.7	873.6	873.6	874.4	0.8
W	41.63	2,880	32,030	1.1	873.9	873.9	874.7	0.8
X	45.55	1,940	27,310	1.3	874.6	874.6	875.4	0.8
Y	47.01	2,100	19,920	1.1	874.8	874.8	875.6	0.8
Z	47.25	3,000	19,010	1.2	874.9	874.9	875.7	0.8

[1]Miles Above Polk County Limits [2]Floodway Data Only For Norman County

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

NORMAN COUNTY, MN

(UNINCORPORATED AREAS)

FLOODWAY DATA

RED RIVER OF THE NORTH

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET) [1]	SECTION AREA (SQUARE FEET) [1]	MEAN VELOCITY (FEET PER SECOND) [1]	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Red River of the North (Cont'd)								
AA	49.89 [2]	2,860	27,770	1.2	875.6	875.6	876.4	0.8
AB	52.54 [2]	180	4,330	2.8	876.4	876.4	877.2	0.8
AC	53.35 [2]	290	5,840	0.9	876.5	876.5	877.3	0.8
AD	54.22 [2]	2,300	16,390	1.4	876.5	876.5	877.3	0.8
AE	55.79 [2]	2,490	27,970	0.9	877.2	877.2	878.0	0.8
Wild Rice River (At Hendrum)								
A	6.61 [3]	1,430	16,010	0.7	869.3	869.3	869.8	0.5
B	8.86 [3]	1,150	7,420	1.6	870.3	870.3	870.8	0.5

[1] Floodway Data Only For Norman County [2] Miles Above Polk County Limits
[3] Miles Above Confluence With Red River of the North

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

NORMAN COUNTY, MN
(UNINCORPORATED AREAS)

FLOODWAY DATA

RED RIVER OF THE NORTH-WILD RICE RIVER

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Therefore, the entire floodway fringe as defined by the conveyance floodway should not be filled. Table 3 shows the percentage of the effective flood storage area in the floodway fringe which can be lost due to filling or diking without causing a significant change in the flood discharge.

Although the existing data base is adequate to develop a profile of the 100-year frequency flood for Wild Rice River near Ada, it is not adequate to evaluate an encroached floodway due to the unique complexity of the flood plain. The extensive width of the flood plain, the numerous roads and culvert systems which bisect the flood plain, and the importance of valley storage preclude usage of traditional HEC-2 methods of floodway evaluation.

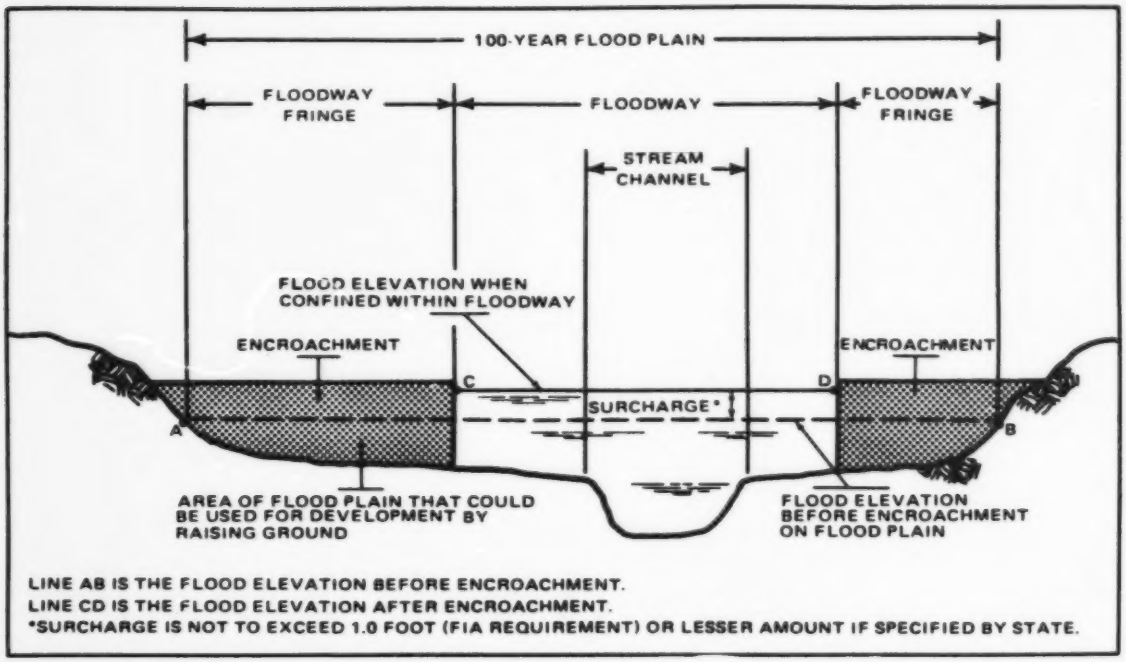
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

Figure 2. Floodway Schematic

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the Federal Insurance Administration has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting Norman County.

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Table 3. Floodway Fringe Fill

Flooding Source and Cross Section	Floodway Fringe Fill (Percent)
Red River of the North	
A	20
B	15
C	10
D	20
E	10
F	20
G	25
H	20
I	25
J	25
K	25
L	35
M	20
N	10
O	25
P	15
Q	45
R	25
S	20
T	20
U	20
V	25
W	25
X	20
Y	20
Z	20
AA	20
AB	15
AC	20
AD	15
AE	20

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5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding sources of Norman County are shown on the Flood Profiles (Exhibit 1) and summarized in Table 4.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is the Federal Insurance Administration device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHF are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective Flood Hazard Factors, the entire unincorporated area of Norman County was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A: Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or Flood Hazard Factors determined.

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Red River of the North							
Reach 1	0005,0025	-9.1	-1.5	2.7	090	A18	Varies - See Map
Reach 2	0025,0045	-5.8	-0.7	2.5	060	A12	Varies - See Map
Shallow Flooding	0005,0045	N/A	N/A	N/A	N/A	A0	Depth 1
Shallow Flooding	0005,0025	N/A	N/A	N/A	N/A	A0	Depth 3
Shallow Flooding	0025,0045	N/A	N/A	N/A	N/A	A0	Depth 2
Wild Rice River							
Reach 1	0025	-5.8	-1.0	2.6	060	A12	Varies - See Map
Reach 2	0030,0050	-2.8	-0.5	0.8	030	A6	Varies - See Map
Reach 3	0030	-0.9	-0.3	0.5	010	A2	Varies - See Map
Reach 4	0030	-2.1	-0.4	1.0	020	A4	Varies - See Map
Reach 5	0030,0035	-0.8	-0.2	0.5	010	A2	Varies - See Map
Shallow Flooding	0025,0030 0035	N/A	N/A	N/A	N/A	A0	Depth 2
Shallow Flooding	0025	N/A	N/A	N/A	N/A	A0	Depth 3

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

NORMAN COUNTY, MN

(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

RED RIVER OF THE NORTH-WILD RICE RIVER

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Zone A0:	Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; depths are shown, but no Flood Hazard Factors are determined.
Zones A2, A4, A6,and A12, and A18:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to Flood Hazard Factors.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

The flood elevation differences, Flood Hazard Factors, flood insurance zones, and base flood elevations for each flooding source studied in detail in the county are summarized in Table 4.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for Norman County is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the Federal Insurance Administration.

6.0 OTHER STUDIES

The Red River of the North Regional Flood Analysis, prepared by the North Dakota State Water Commission and the Minnesota Department of Natural Resources (Reference 18), presents approximate 100-year flood profiles for Red River of the North as extrapolated from existing rating curves. Water-surface elevations presented in the report, however,

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do not agree with water-surface elevations for Red River of the North presented in the Halstad Flood Insurance Study (Reference 14), the Hendrum Flood Insurance Study (Reference 15), and the Perley Flood Insurance Study (Reference 16). The discrepancies occur because the Flood Insurance Study used surveyed cross section data and more detailed hydraulic analyses with Manning's equation to determine water-surface elevations.

The Flood Insurance Rate Map for the Township of Noble, North Dakota (Reference 19), is in general agreement with this Flood Insurance Study. Discrepancies in water-surface elevations are due to surveyed cross section data and more detailed hydraulic analyses with Manning's equation used in this study.

Flood Insurance Studies have been prepared for the Cities of Halstad, Hendrum, and Perley (References 14, 15, and 16). This study is in agreement with the Halstad study. The zone designations in the Hendrum study do not agree with this study because the elevations of the roads in Hendrum are close to the 100-year flood elevations, which results in the roads acting as dikes to create sheet flow. These areas were designated as Zone B in Hendrum. The Perley Flood Insurance Study is in agreement with this study except at the southern corporate limits, where the depth of the AO zone differs by 1 foot due to the effect of a dike.

The 100-year flood boundaries delineated in the Norman County Flood Insurance Study are not in exact agreement with the approximate boundaries delineated on the U.S. Geological Survey Flood-Prone Area Maps (Reference 20), because the Norman County Flood Insurance Study is based on a more detailed analysis.

This Flood Insurance Study does not agree with the Flood Hazard Boundary Map for Norman County (Reference 17) due to more detailed methods used in this study.

This study is authoritative for the purposes of the National Flood Insurance Program; data presented herein either supersede or are compatible with all previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the Insurance and Mitigation Division, Federal Emergency Management Agency, 1 North Dearborn Street, Chicago, Illinois 60602.

8.0 BIBLIOGRAPHY AND REFERENCES

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11. U.S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 5 feet: Halstad, Minnesota (1963); Perley, Minnesota (1963); Halstad, S.W., Minnesota (1963); Gardner, Minnesota (1963); Ada, Minnesota (1965); Borup, Minnesota (1965); Felton, N.W., Minnesota (1966); Ulen, S.W., Minnesota (1966); Ulen, N.W., Minnesota (1965); Syre, Minnesota (1965); Ulen, Minnesota (1966); Flom, Minnesota (1966); Tilde Lake, Minnesota (1966); Dale, Minnesota (1966); Lake Park, Minnesota (1966); Flom, S.E., Minnesota (1966); Twin Valley, S.W., Minnesota (1965); Twin Valley, Minnesota (1965)

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13. U.S. Department of the Army, Corps of Engineers, Reservoir Regulation Section, Wild Rice River Water-Surface Profiles, July 1970

14. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, City of Halstad, Norman County, Minnesota, December 1978

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17. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, Norman County, Minnesota, Scale 1:24,000, February 1979

18. North Dakota State Water Commission, and Minnesota Department of Natural Resources, Division of Waters, Soils, and Minerals, Red River of the North Regional Flood Analysis, August 1971

19. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Rate Map, Township of Noble, North Dakota, July 1980

20. U.S. Department of the Interior, Geological Survey, 7.5-Minute Flood-Prone Area Maps for Minnesota, Scale 1:24,000, Contour Interval 5 feet, Halstad, Minnesota, 1970; Perley, Minnesota, 1970; Shelly, Minnesota, 1970

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9.0 REVISIONS DESCRIPTION

This section has been added to provide information regarding significant revisions made since the original Flood Insurance Study was printed. Future revisions may be made that do not result in the republishing of the Flood Insurance Study report. To assure that any user is aware of all revisions, it is advisable to contact the community repository of flood hazard data located at the Auditor's Office, Norman County Courthouse, Ada, Minnesota.

9.1 First Revision (Revised August 19, 1987)

a. Acknowledgments

The hydrologic and hydraulic analyses for this Revisions Description were performed by the U.S. Army Corps of Engineers (COE), St. Paul District. The Federal Emergency Management Agency (FEMA) reviewed and accepted these data for purposes of this revision.

b. Scope

A flood control project has been completed under the direction of the COE to protect the City of Halstad and a portion of Norman County from flooding caused by the Red River of the North. This project is an earth levee system which partially surrounds the City of Halstad.

c. Hydrologic and Hydraulic Analyses

Rainfall depths for storms of various frequencies in the Halstad area were developed from National Weather Service publications TP-40 (Reference 1) and HYDRO-35 (Reference 2). In addition, historical rainfall events were investigated for the years of 1963 through 1980. Hydrographs for the watersheds inside the levee system were developed using the SCS unit hydrograph method found in the HEC-1 computer program (Reference 3). The discharge data for the Red River of the North were obtained from the U.S. Geological Survey gage at Halstad for the years of 1962 through 1979.

The levee system has been designed and certified by the COE as providing protection from the 250-year flood.

The area inside the levee system consists of four drainage basins. Four gravity flow stormwater outlets have been provided to remove runoff from the protected area at all times except during flood stages for the Red River of the North. During flood conditions, the gravity outlets are closed and all interior runoff is stored in four ponding areas located inside the levee system. These ponding areas are designed to contain the interior runoff for a 0.54-percent exceedence frequency event. Detailed design criteria for the ponding areas and the drainage structures

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are given in the "Detailed Project Report for Flood Control, Red River of the North at Halstad, Minnesota, Appendix C, Interior Flood Control" (Reference 4). Eight temporary closure devices are included in the levee system. They include earthfill or sandbag closures and a stoplog closure. Further information on these closures and other details relating to the operation of the levee system can be found in the "Operation and Maintenance Manual, Flood Control Project, Red River of the North, Halstad, Minnesota" (Reference 5). Construction details and "as-built" drawings for the project are contained in "Flood Control Project, Red River of the North, Halstad, Minnesota, Appendix A - Project Drawings" (Reference 6).

d. Floodways

The floodway for the Red River of the North has been widened from approximately 3,100 feet upstream of Minnesota Trunk Highway 200 to approximately 5,200 feet downstream of Minnesota Trunk Highway 200. Cross section L, 2,800 feet downstream of Minnesota Trunk Highway 200, has been widened from 2,620 feet to 3,800 feet on the Norman County side of the Red River of the North (see Table 2). The floodway has been widened to include the entire area located between the river and the levee. No new floodway analyses were performed for the Red River of the North.

e. References and Bibliography

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5. ----------, St. Paul District, Operation and Maintenance Manual, Flood Control Project, Red River of the North, Halstad, Minnesota, February 1986.

6. ----------, St. Paul District, Flood Control Project, Red River of the North, Halstad, Minnesota, Appendix A - Project Drawings, December 1985.

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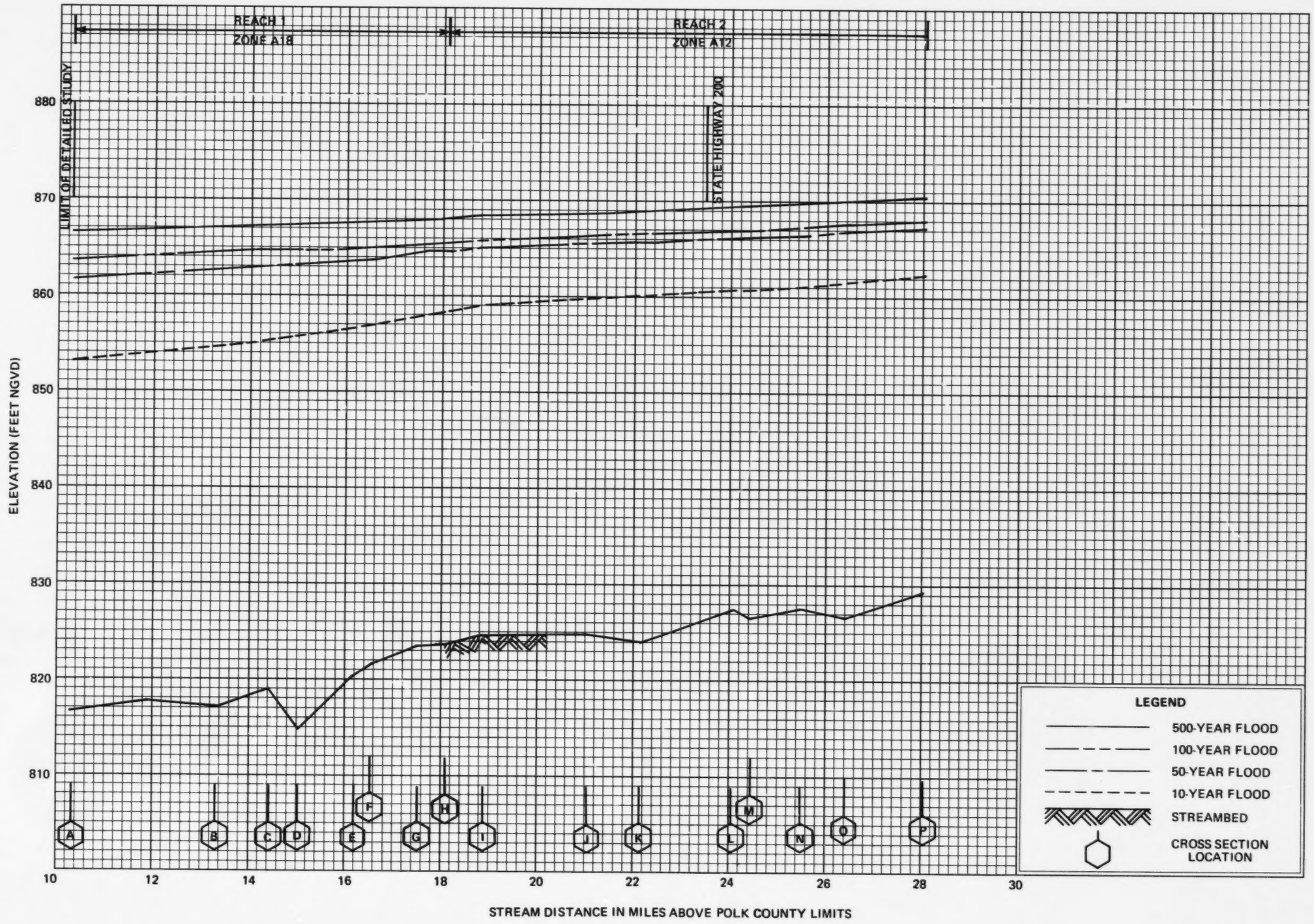

FLOOD PROFILES

RED RIVER OF THE NORTH

FEDERAL EMERGENCY MANAGEMENT AGENCY

NORMAN COUNTY, MN
(UNINCORPORATED AREAS)

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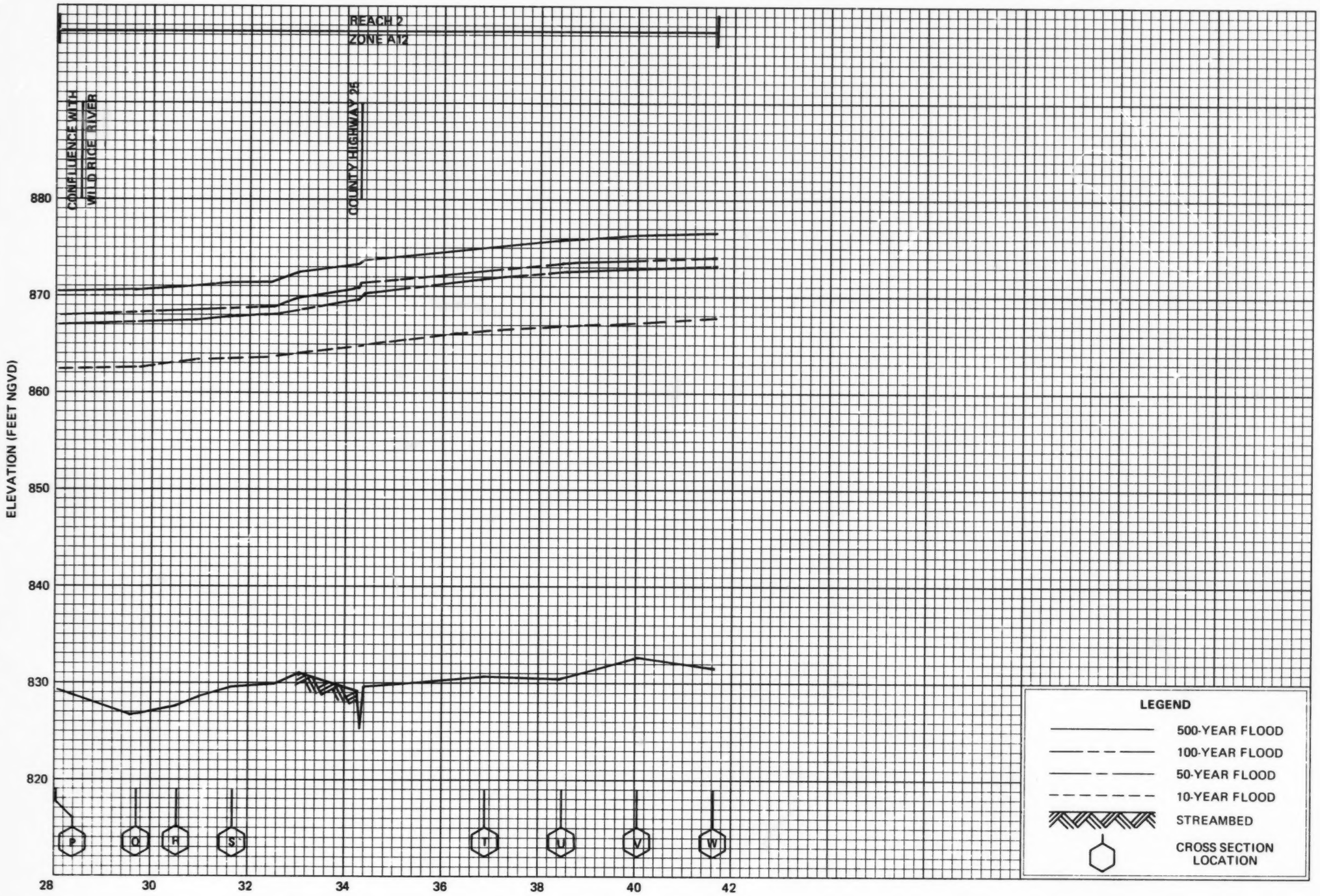

FLOOD PROFILES

RED RIVER OF THE NORTH

FEDERAL EMERGENCY MANAGEMENT AGENCY

NORMAN COUNTY, MN
(UNINCORPORATED AREAS)

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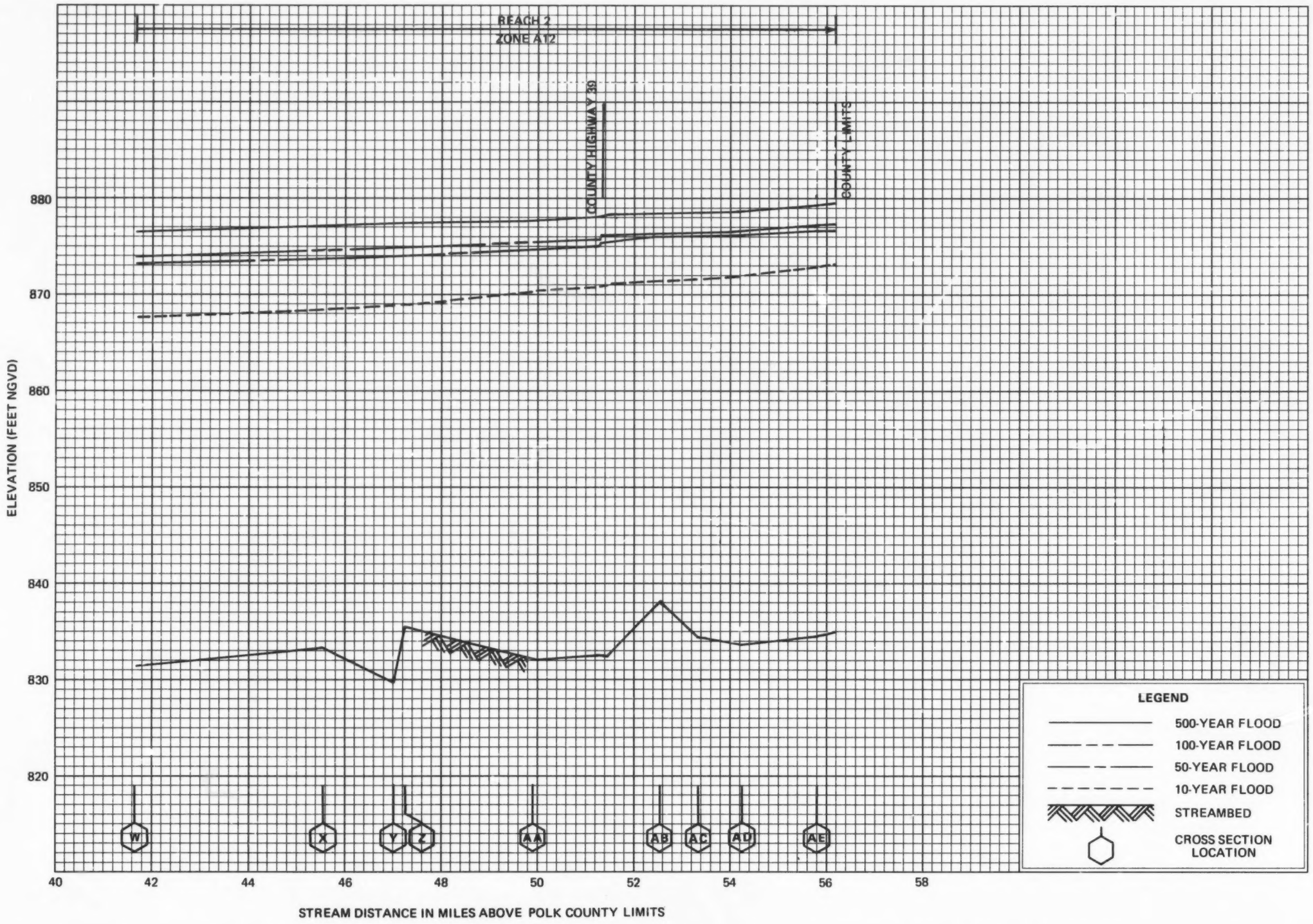

FLOOD PROFILES

RED RIVER OF THE NORTH

FEDERAL EMERGENCY MANAGEMENT AGENCY

NORMAN COUNTY, MN
(UNINCORPORATED AREAS)

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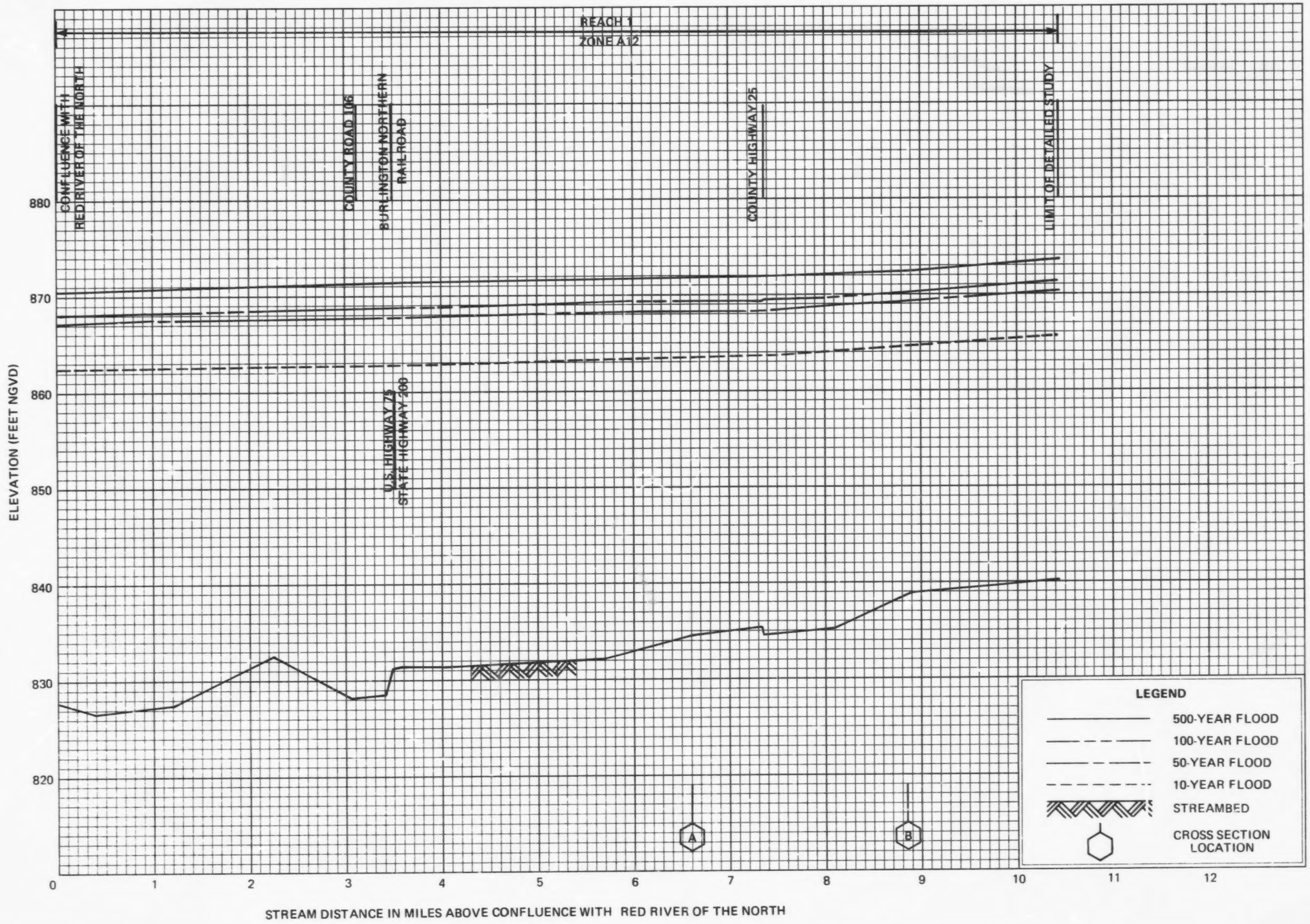

FLOOD PROFILES

WILD RICE RIVER (AT HENDRUM)

FEDERAL EMERGENCY MANAGEMENT AGENCY

NORMAN COUNTY, MN
(UNINCORPORATED AREAS)

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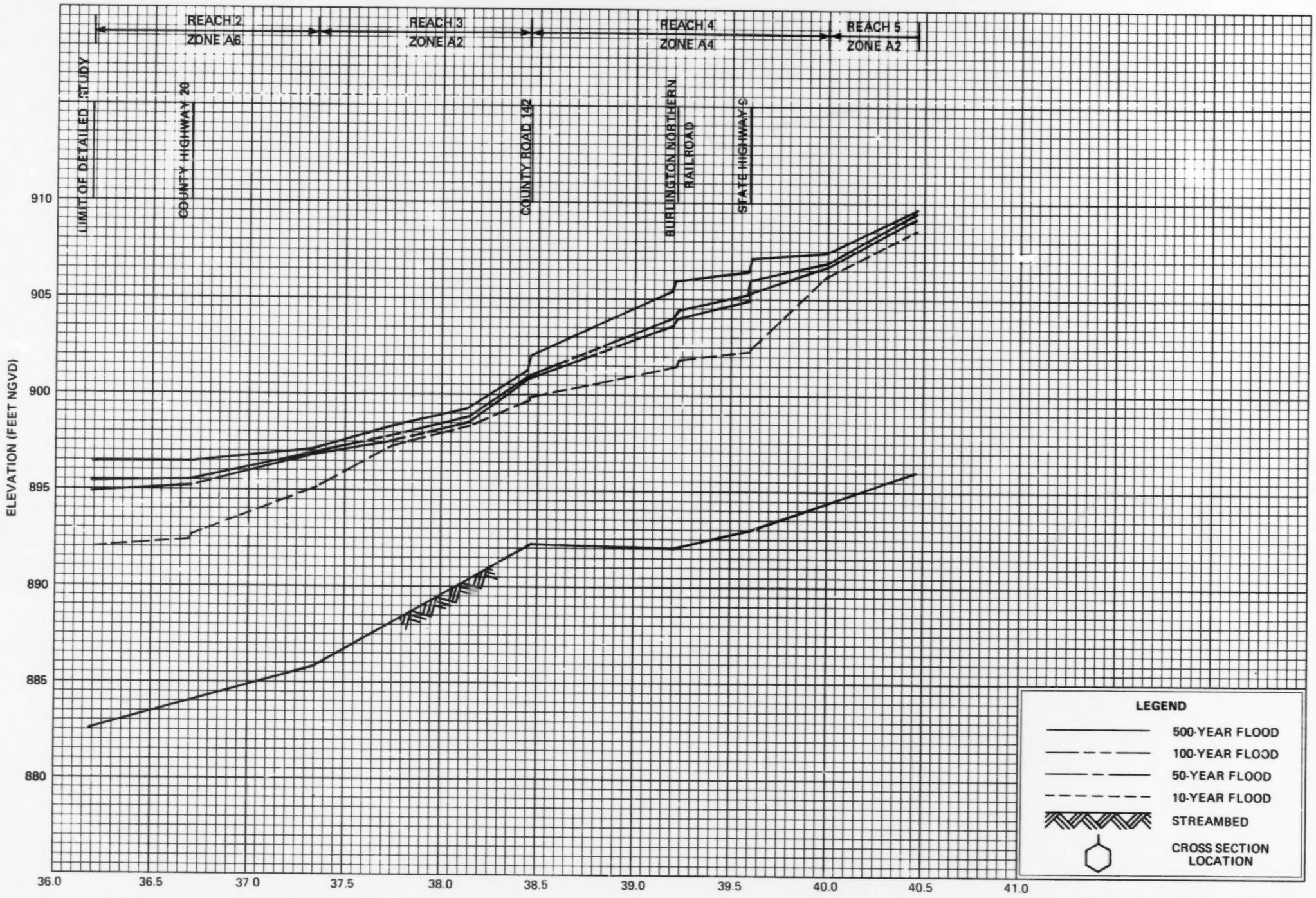

FLOOD PROFILES

WILD RICE RIVER (NEAR ADA)

FEDERAL EMERGENCY MANAGEMENT AGENCY

NORMAN COUNTY, MN
(UNINCORPORATED AREAS)

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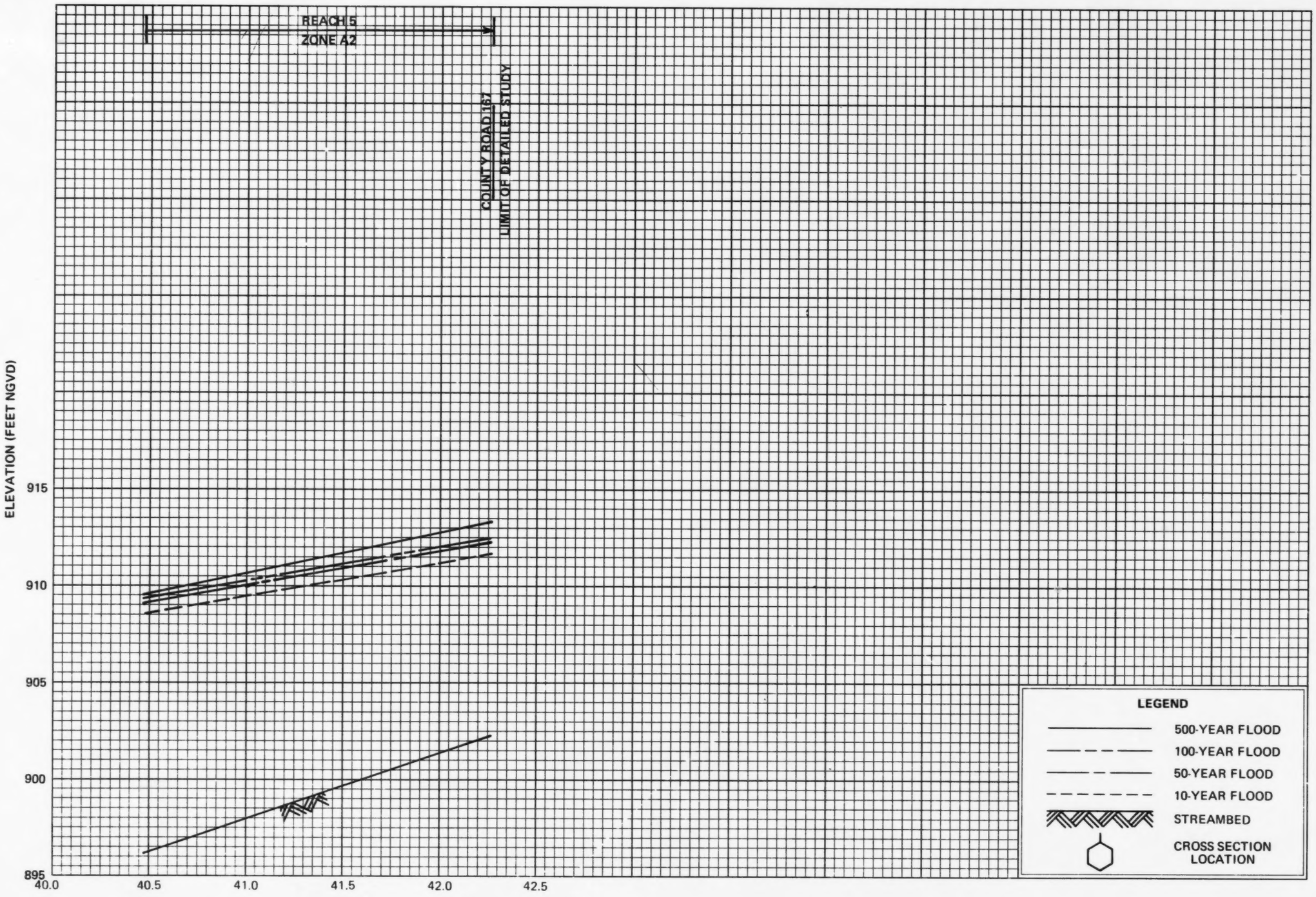

FLOOD PROFILES

WILD RICE RIVER (NEAR ADA)

FEDERAL EMERGENCY MANAGEMENT AGENCY

NORMAN COUNTY, MN
(UNINCORPORATED AREAS)

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